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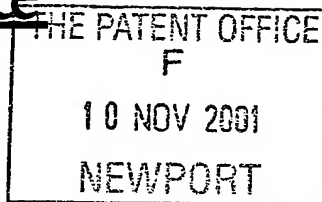
Dated

07 JAN 2002

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# Request for grant of a patent

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|                   |                 |   |
|-------------------|-----------------|---|
| 1. Your reference | IMAB / P24990GB | 12NOV01 E673957-1 002866<br>P01/7700 0.00-0127090.9 |
|-------------------|-----------------|---|

|  |                                 |
|--|---------------------------------|
| 2. Patent application number<br>(The Patent Office will fill in this part) | 10 NOV 2001<br><b>0127090.9</b> |
|--|---------------------------------|

|   |   |
|---|---|
| 3. Full name, address and postcode of the or of each applicant (underline all surnames) | <b>Image Portal Limited</b><br>Crocus Street<br>Nottingham<br>NG2 3DR<br>United Kingdom |
|---|---|

0826600 9001

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

United Kingdom

|                           |         |
|---------------------------|---------|
| 4. Title of the invention | DISPLAY |
|---------------------------|---------|

|   |  |
|---|--|
| 5. Name of your agent (if you have one) | <b>ERIC POTTER CLARKSON</b><br><b>PARK VIEW HOUSE</b><br><b>58 THE ROPEWALK</b><br><b>NOTTINGHAM</b><br><b>NG1 5DD</b> |
|---|--|

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1305010

|  |         |   |  |
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| 6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number | Country | Priority application number<br>(if you know it) | Date of filing<br>(day / month / year) |
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|   |                               |  |
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|  |     |
|--|-----|
| 8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if: | YES |
|--|-----|

- a) any applicant named in part 3 is not an inventor; or
- b) there is an inventor who is not named as an applicant, or
- c) any named applicant is a corporate body.  
See note (d))

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Continuation sheets of this form

Description 9

Claims(s) 3

Abstract 0

Drawing(s) 7

10. If you are also filing in any of the following, state how many against each item.

Priority Documents 0

Translations of priority documents 0

Statement of inventorship and right to grant of a patent (Patents Form 7/77) NO

Request for preliminary examination and search (Patents Form 9/77) NO

Request for substantive examination (Patents Form 10/77) NO

Any other documents  
(please specify)

11.

I/We request the grant of a patent on the basis of this application.

*Eric Potter Clarkson*

Signature

ERIC POTTER CLARKSON

Date

9 November 2001

12. Name and daytime telephone number of person to contact in the United Kingdom

0115 9552211

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## DISPLAY

The present invention relates to a display, especially a display incorporating an array of OLED pixels, or an OLED backlight used in conjunction with an array of LCD pixels.

Existing types of display unit (whether incorporating cathode ray tubes, liquid-crystal displays or plasma panels) have a region of no display along their perimeter. Thus, when display units of a given type are bolted together to form larger display, these dead-areas are plainly visible, dividing up the resultant screen into a grid, thereby limiting the overall effect of the composite screen.

In the last two years, displays incorporating OLED (Organic Light Emitting Device) material have been developed for use in automotive dashboards, instrument panels and car radios in order to make good use of the known characteristics of good power efficiency, thermal stability and extended lifetime.

The present invention provides a display comprising a plurality of display regions, each incorporating Organic Light Emitting Device (OLED) material, each region comprising a plurality of separately addressable pixel elements, one or more of the display region(s) overlying a portion of one or more adjacent display region(s).

Thus, the portion of the display region which is underneath said pixel is not visible to a viewer of the display, so that that portion can be used for wiring connections and leads to that display region without causing any detrimental effect to the overall appearance of the display.

Furthermore, the display area may be arranged such that one or more further display regions overlie part of said first display region(s).

Thus, that portion of the display region of said pixel element can be used for the wiring connections and/or leads to said pixel element.

Thus, preferably, the display array comprises a plurality of display regions of the pixels which overlie part of the display regions of laterally and/or orthogonally adjacent display regions.

10

The present invention also provides a plurality of substrates, each comprising a first portion to support a display region incorporating an Organic Light Emitting Device (OLED) material with a plurality of separately addressable pixel elements, and a second portion which underlies part of another substrate.

15

This display may include one or more of the following features:-

- The first portion and the second portion of a substrate are not in the same plane;
- 20 • The first portion and the second portion of a substrate are in substantially parallel planes;
- The first and second portions of a substrate are in a stepped relationship;
- The first and second portions of a substrate are arranged generally in a U-shape;
- 25 • The second portion incorporates wiring and/or electrical connections;
- The first portion comprises a substrate to hold a glass panel of OLED material;
- The first portion comprises a moulded substrate of plastics material;
- A flexible heat seal means to ensure high integrity electrical connections
- 30 between drive electronics and said pixels.

The present invention is particularly suited to displays for advertising screens in public places, and to displays for customer information at train or bus stations and airports, typically with screens up to 3 metres by 2 metres.

5

However the present invention is also suited to applications incorporating displays which are smaller or larger than these application; also the present invention is also suited to displays which are of any appropriate shape, for example square or rectangular or have an complex outline, for L-shaped and  
10 the perimeter any have side which are straight/and or arcuate.

The present invention is applicable to displays in which illumination is provided soley by the material and also displays in which back lighting of the display is provided. Thus, the present invention includes embodiments  
15 wherein the pixel elements operate as a shutter whether soley with the on/off capability or with also a graded grey-scale capability.

In order that the invention may more readily be understood, a description is now given, by way of example only, reference being made to the  
20 accompanying drawings, in which:

Figure 1 is a schematic view of part of a conventional tiled display;

Figure 2 is a side view of a number of adjacent elements of a display embodying the present invention;

Figure 3 is a view of part of the front of display of Figure 2;

25 Figure 4 is a perspective exploded view of an element of Figure 2;

Figures 5 and 6 are perspective views of a second embodiment of element in two states;

Figures 7 to 9 are examples of pixel shapes and direct-addressing arrangements for use in the display of the present invention;

30 Figure 10 shows the glass substrate for the display of Figure 2;

Figure 11 shows the tracking for the display of Figure 2;  
Figure 12 shows the pixel layout for the display of Figure 2;  
Figure 13 shows the metal cathode configuration for the display of  
Figure 2; and

5        Figure 14 shows the encapsulation for Figure 2.

Figure 1 illustrates the inherent problem with attempts to form a larger  
display 1 using discrete displays 2 incorporating known technologies for  
example cathode ray tubes, liquid crystals and plasma panels. All these  
10 technologies have dead areas 3 surrounding the areas 4 which actually  
represent the image being displayed, such that when a number of displays 2  
are bolted together to form a the larger display 1 the dead areas from  
adjacent displays 2 combine together and become plainly visible, effectively  
dividing up the screen into a grid array thereby seriously deteriorating the  
15 overall effect of the display 1 and detracting from the appearance of the  
image being displayed.

There is shown in Figure 2 an arrangement of three adjacent display tiles  
10, each having a mould plastics support 11, a glass panel 12 incorporating  
20 the OLED element (see Figure 4) and a interface pcb 17.

These tiles 10 form part of a full-colour advertising screen of dimensions  
1.2 metre by 1.8 metre, used in indoor public places.

25 Another application for such a display is a Customer Information display,  
for example for use in train stations, bus stations and airports. The display  
screen is of any size and shape, from one-character rows to display screens  
up to typically 3 metre by 2 metre.

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7  
The pixel element size is typically in the range of 1 to 10 mm for example 3 mm, and the pixels may be of any colour combination.

The three display tiles 10 are overlapped to eliminate the grid effect, and  
5 held in place by mechanical (in the form of posts 13) and electrical  
interfaces (in the form of electrical connectors 14 and sockets 18) that  
mount each display tile 10 onto a motherboard 15. The motherboards 15  
may also be tiled within a casing to build up screens of virtually any shape  
and size the design allows for display tiles on one motherboard to overlap  
10 with tiles on the second motherboard in the same manner as with each tile  
on a motherboard.

In this way, dead areas surrounding the active pixel area displayed and  
necessary to accommodate wiring and/or electrical leads for driving of the  
15 pixel elements are hidden behind active image areas, this being made  
possible by the thin characteristic of OLED devices. The resultant overlap  
reduces the grid effect seen on other tiled large area displays to a negligible  
level. This technique applied to both OLED pixel array tiles and LCD tiles  
using an OLED backlight.

20

Each display tile 10 is 73.8mm wide, 33mm high, and 1.7 mm thick, and  
1500 tiles are combined together to form a display area of approximately  
1.2 by 1.8 metres.

25 The support 11 of display tile 10 has a compound angle introduced by  
overlapping tiles on the bottom and right hand edges on the front face to  
allow tiling of a number of supports 11. Support 11 holds the glass panel 12  
and a connector/printed circuit board provides the compound angle  
necessary to stack and tile the OLED panels.

30



A heatseal connector (not shown) is arranged in a "L" shape to attach to the bottom and right hand sides of the OLED glass panels 12. These may be any two adjacent sides of the device depending upon which orientation the compound angle and panel overlap is required. If the top and left hand side  
5 form heatseal connections instead of the bottom and right hand sides, the overlapping will take place around the new position of the heatseal connections.

Figure 3 illustrates part of the display screen 20 formed by a 2-dimensional  
10 matrix of display tiles. In order to assemble the tiles onto a motherboard 15, the following steps are taken: interface pcb 17<sub>1</sub> is placed on the post 13<sub>1</sub>, at the top left-hand-most position on the motherboard 15, then the corresponding tile 10<sub>1</sub>, is placed on the interface pcb 17<sub>1</sub>.

15 Thereafter, the same actions are taken in respect of interface pcb 17<sub>2</sub>, post 13<sub>2</sub> and tile 10<sub>2</sub> for the next position vertically below but in the same column, and so on until the first column is filled. Then the sequence is repeated for the second column, starting at the top and finishing at the bottom, and being repeated for each column in turn.

20

In a variant, the tiles 10 are assembled row, by row starting from the top lefthand corner.

In an alternative embodiment of display tile 30, printed circuit board 31 is  
25 folded under the glass OLED panel 32 (see Figures 5 and 6), a modified moulded plastics support 33 providing the required compound angle and holding the printed circuit board 31 which is appropriately dimensioned to ensure that there is no conflict with other printed circuit boards from adjacent tiles 30.

30

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In a further alternative embodiment, there is no printed circuit board and connector, the heatseal is plugged directly into the motherboard, removing the need of a separate connector and making the arrangement more cost effective and producing a thinner screen.

5

For direct pixel addressing applications, only one side of the OLED glass panels 12 is required for heatseal bonding, to accommodate the tracking in-between the active pixels. Figures 7 to 9 show some of the possible arrangements for direct addressing.

10

A display tile 10 is not reliant upon any particular defined pixel layout. In order to produce full colour displays, it is necessary to use red, green and blue pixel elements as a minimum. There may also be cases where a further white element is used to increase the white saturation of the image. For the  
15 backlight application, any colour or areas of colour may be used.

Pixel element shapes may be square, rectangular, circular, triangular, oval or indeed any geometric form and size.

20 The size of the red, green, blue (and white, if included), are in the range of 1mm pixel pitch to 15mm pitch, though the present invention is not limited to any pixel size, shape or arrangement. Dimensions of the backlighters for those embodiments are the same as the particular size of LCD tile used for the application.

25

Figure 10 shows a colour pixel OLED glass panel 12 formed from a glass substrate being a rectangular section of glass, 0.7 mm thick. The dimensions of the glass are illustrated below, including the positioning of the first upper left-hand corner of the pixel array.

30

Upon the glass substrate, the device is built up in the following layers:-

1. ITO anode
2. Organic stack (pixels)
- 5 3. Metal cathode
4. Encapsulation

All of the tracks are 1mm wide and fall directly onto the vertical layout of the pixels (organic stack). The ITO tracks comprise groups of three 1mm  
10 tracks, each track being 0.1 mm apart, with each group of three being 0.2 mm apart. The first track on the left-hand side starts in the same location as indicated for the pixels on the definition of the glass substrate.

The length of each track is 27.2 mm, such that each track is visible by 0.2  
15 mm below the bottom row of pixels.

In the next 0.8 mm, the tracking is reduced in width gradually until it is 0.5 mm. In the remaining 2 mm of glass, the tracks is bunched together to form 0.5 mm ITO with 0.6 mm gap in a RGB group of 0.7 mm in-between RGB  
20 groups. This is repeated for the entire length of the new connector region (see Figure 11).

The pixels are formed into an array of 20 x 8 (67.8 mm x 27 mm). The pixel pitch is 3.4 mm, with a fill-factor of 83% (see Figure 12).

25

The metal cathode layer comprises no more that eight strips each 3.2 mm wide, 0.2 mm apart, starting in exactly the same place at the top left-hand pixel (see Figure 13).

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This time, the tracking protrudes 0.2 mm from the edge of the last column of pixels, reducing from 3.2 mm to 1 mm width within 0.8 mm and remaining a constant 1 mm width for the remaining 2 mm until the edge of the glass is reached.

5

The encapsulation is located 1 mm in from the top and 1 mm from the left side of the glass substrate.

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## CLAIMS

1. A display comprising a plurality of display regions, each  
5 incorporating Organic Light Emitting Device (OLED) material, each region  
comprising  
a plurality of separately addressable pixel elements,  
one or more of the display region(s) overlying a portion of one or  
more adjacent display region(s).
- 10 2. A display according to Claim 1 wherein one or more further display  
regions overlie part of said first display region(s).
3. A display array according to Claim 1 or 2 wherein the portions of  
15 display areas which lie underneath other display areas incorporate wiring  
and/or electrical connections.
4. A display according to any preceding claim comprising a plurality of  
display regions which overlie part of the display regions of laterally and/or  
20 orthogonally adjacent display regions.
5. A display according to any preceding claim wherein the display  
regions form a substantially continuous display surface over the array.
- 25 6. A display comprising a plurality of substrates, each comprising a first  
portion to support a display region incorporating an Organic Light Emitting  
Device (OLED) material with a plurality of separately addressable pixel  
elements, and a second portion which underlies part of another substrate.

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7. A display according to Claim 6 wherein the first portion and the second portion of a substrate are not in the same plane.
8. A display according to Claim 6 or 7 wherein the first portion and the second portion of a substrate are in substantially parallel planes.
9. A display according to any one or more of Claims 6 to 8 wherein the first and second portions of a substrate are in a stepped relationship.
10. A display according to any one or more of Claims 6 to 9 wherein the first and second portions of a substrate are arranged generally in a U-shape.
11. A display according to any one or more of Claims 6 to 10 wherein the second portion incorporates wiring and/or electrical connections.
12. A display according to any one or more of Claims 6 to 11, wherein the first portion comprises a substrate to hold a glass panel of OLED material.
13. A display according to any one or more of Claims 6 to 12 wherein the first portion comprises a moulded substrate of plastics material.
14. A display according to any one or more of Claims 6 to 13 comprising heat seal means to ensure high integrity connection of display to drive electronics.
15. A display according to any preceding claim wherein the pixel elements have integral means to generate illumination.

16. A display according to any preceding claim comprising means to effect back lighting illumination of a plurality of pixel elements.

17. A display substantially as hereinbefore described with reference to, and/or as illustrated in, any one or more of Figures 2 to 14 of the accompanying drawings.

18. A display element comprising a substrate for a display according to any preceding claim, the substrate comprising a first portion to support a display region incorporating an Organic Light Emitting Device (OLED) material with a plurality of separately addressable pixel elements, or an OLED backlight, and a second portion to underlie part of another substrate.

19. A display element substantially as hereinbefore described with reference to, and/or as illustrated in, any one or more of Figures 2 to 13 of the accompanying drawings.

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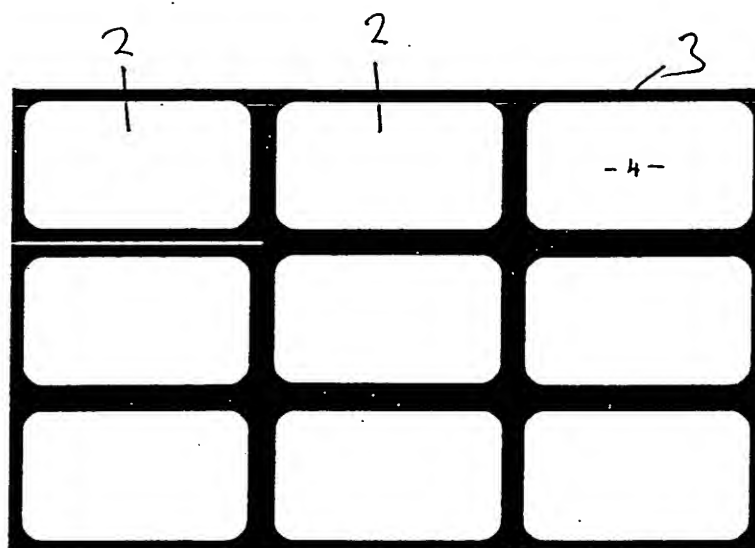
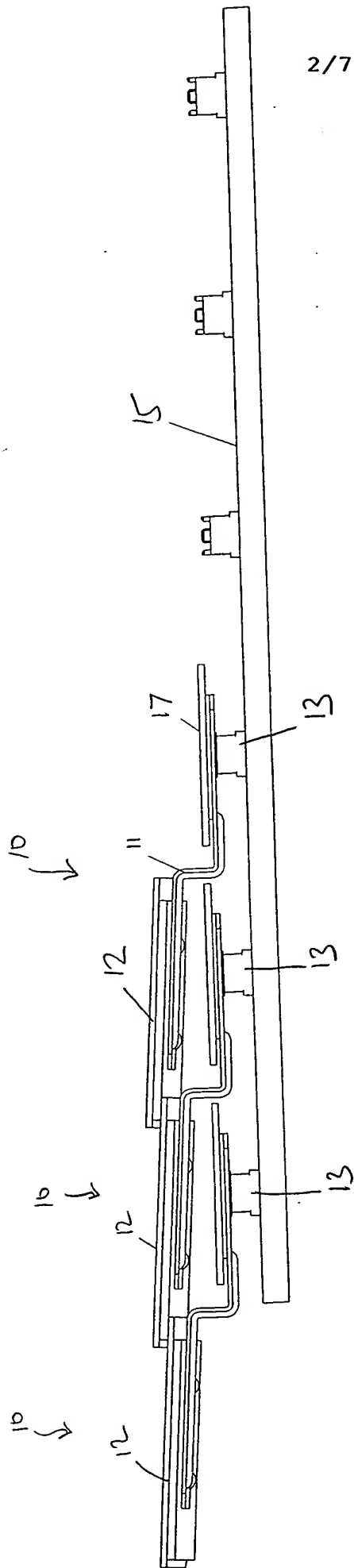


FIGURE 1





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Figure 2

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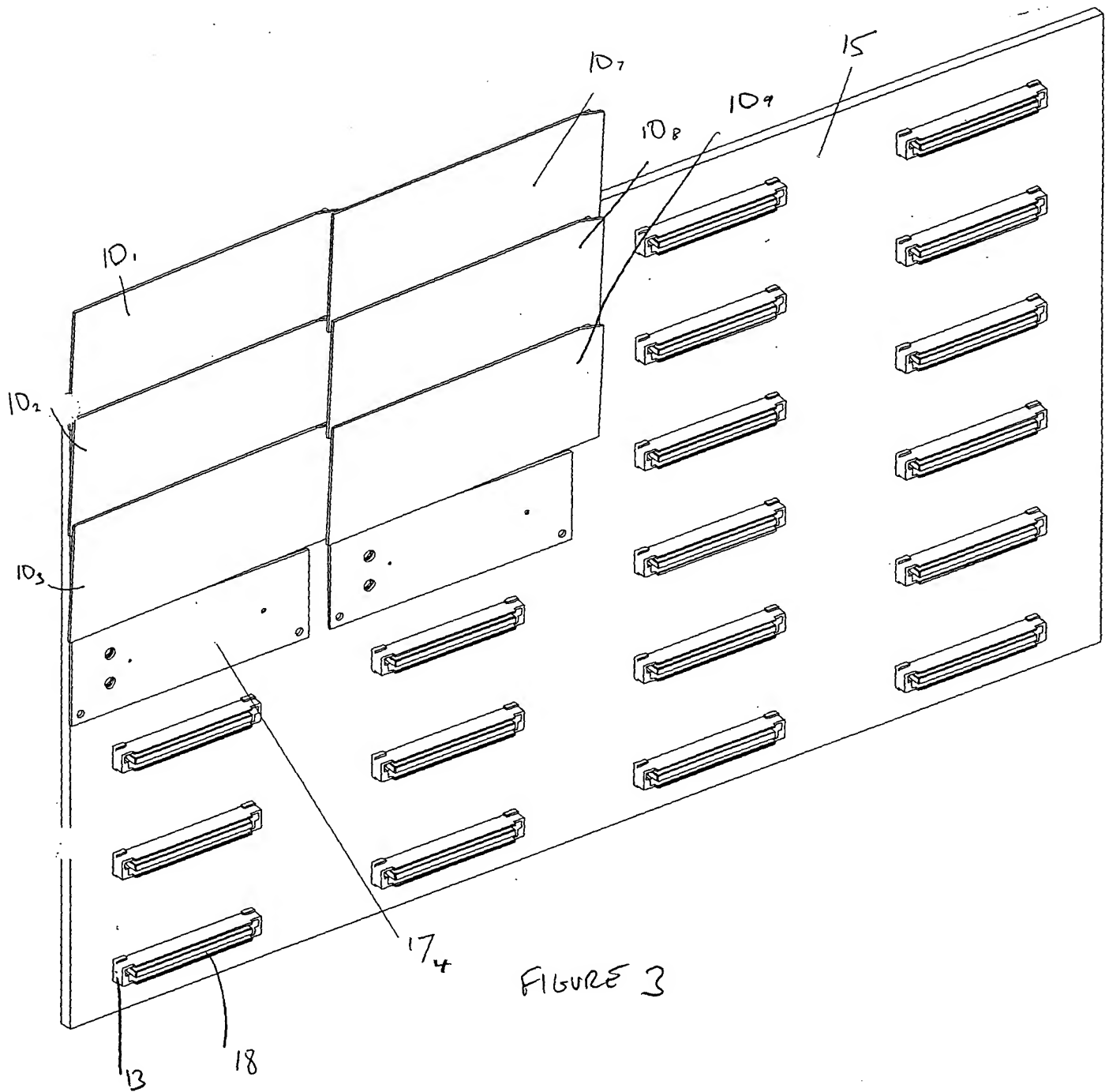


FIGURE 3

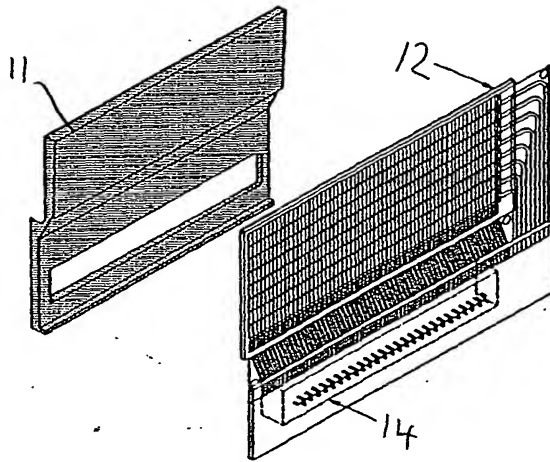


FIGURE 4

← 30

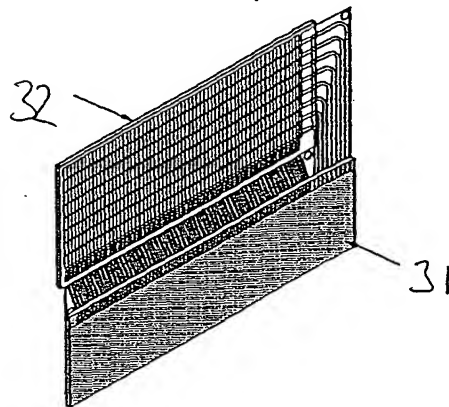


FIGURE 5

← 30

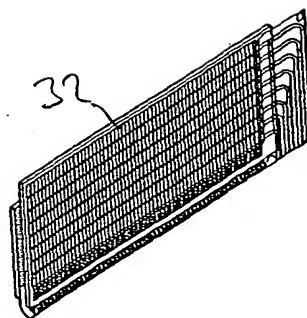


FIGURE 6

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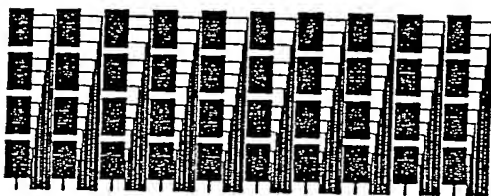


FIGURE 7

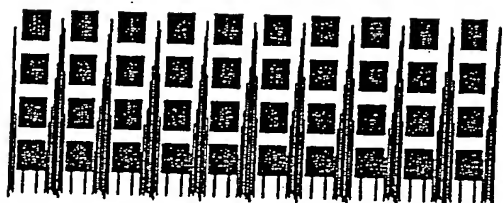


FIGURE 8

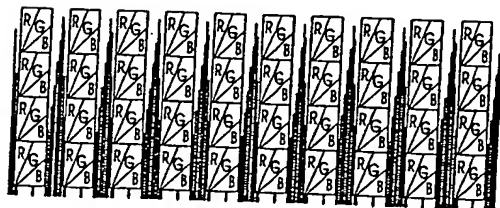


FIGURE 9

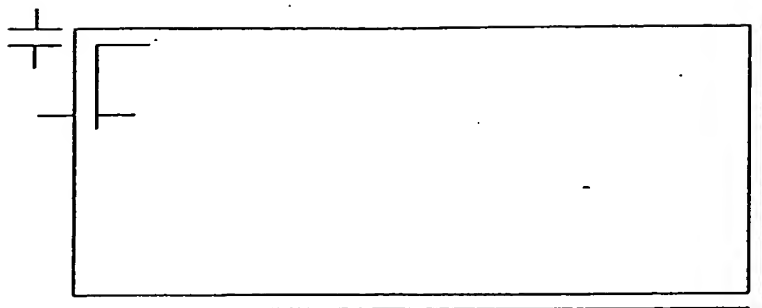


FIGURE 10

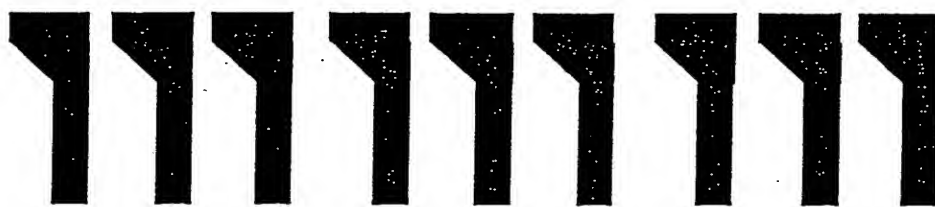


FIGURE 11

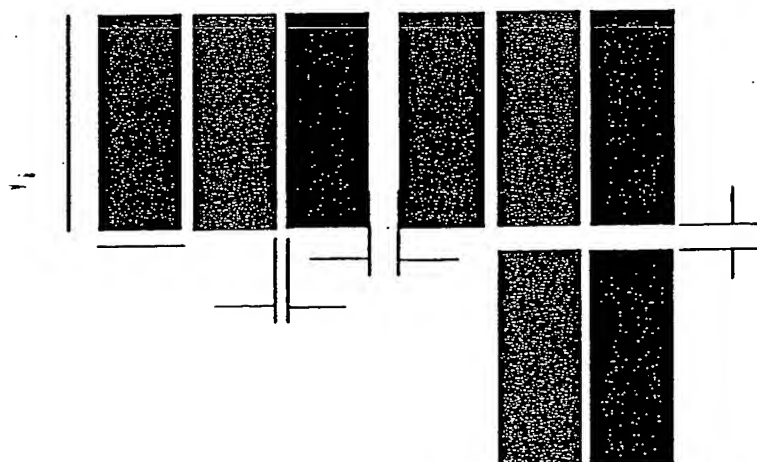


FIGURE 12

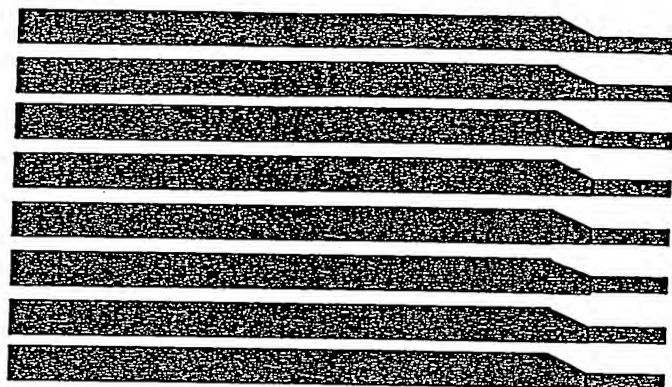


FIGURE 13

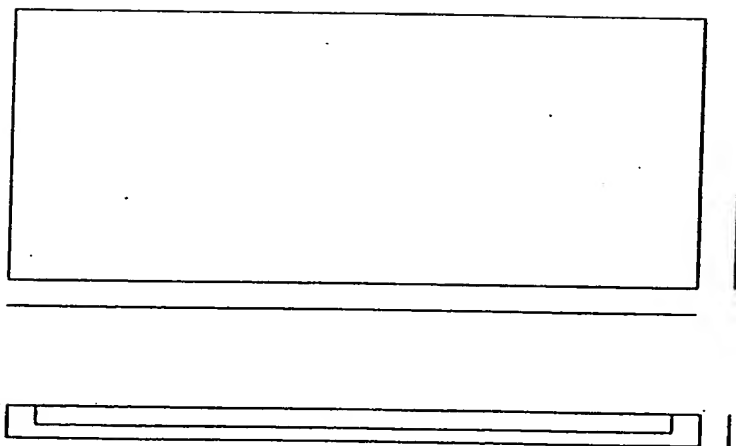


FIGURE 14